DIVERSITY AND DISTRIBUTION OF THE EDAPHIC MITES (*ACARI: GAMASINA, ORIBATIDA*) IN SOME FOREST PLANTATIONS FROM THE CENTRAL MOLDAVIAN PLATEAU

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Abstract

This study is devoted to the knowledge of two representative groups of edaphic microarthropods from the organic horizon of some forest plantations placed in the Central Moldavian Plateau. Examination of faunistic material sampled from forest plantations resulted in identification of 21 species, 12 genera and 9 families belonging to the suborder *Gamasina* Leach, 1815, and 59 species, 41 genera and 28 families of the order *Oribatida* Dugès, 1834. There were recorded two new species for Romanian fauna: *Hypoaspis heselhausi* Oudemans, 1912 and *Oribatella (O.) similesuperbula* Weigmann, 2001, beside a number of rare, less cited species. Oribatid mites are the dominant group in all analyzed stands, especially in terms of abundance, a situation often encountered in natural forest ecosystems. Concerning the autecological features the analyzed fauna get together in close proportions grassland and euryplastic species, while the preferential sylvicolous species are less represented. In mixed plantations with an age over 10 years, mites' fauna is more diversified and the average abundance is higher than in very young ones. Comparative analysis of communities' structure revealed that anthropogenic pressure and any limiting factors from some stands (most forest plantations were established on degraded lands) are reflected at the edaphic coenosis level by reducing the global abundance and number of species, with consequences to stability and functionality of the ecosystem as a whole.

Key words: mites, Gamasina, Oribatida, plantations, diversity

Central Moldavian Plateau, a subunit of Bârladului Plateau is located in its northern part being a transition area between biopedoclimatic features of Suceava Plateau and southeastern steppe. In the early 90's some complex ecological research has been undertaken in the main types of natural forest ecosystems of Central Moldavian Plateau (Huţu, M., Bulimar, F., 1993, Bulimar F. et. al., 1993, Ivan O., 1995), but forest plantations have not been investigated so far, from a similar ecological perspective. These anthropogenic ecosystems perform a number of functions of great importance, from the ecological, economical and social point of view (stopping soil erosion, prevent flooding, landslides, snowdrift etc) and improve degraded terrains. This research aimed to investigate the structure and functioning of forest plantations in Central Moldavian Plateau, through the analysis of the abundance, species composition and diversity of two important groups of the edaphic mites – *Oribatida* and *Gamasina*.

The oribatids are detritophytophagous mites with an active participation to decomposition of vegetal necromass in soil. The special selectivity of these organisms to the life conditions, designate them as valuable bioindicators of soil quality and edaphic modification produced after human intervention. The great majority of *Gamasina* are predators, so the abundance and community structure of these mites reflect mostly the availability of their prey. However, several genera are considered good bioindicators of habitat and soil condition (Karg W., 1993, Krantz, G. W., Walter, D. E., 2009).

Some of our previous works were dedicated to the edaphic communities of oribatid and gamasid mites from the organic horizon of some forest ecosystems, inclusively plantations, from a nearby region – Moldavian Plain, being an important reference point for the present researches (Călugăr A., 2010, Ivan O., 2007).

MATERIAL AND METHOD

After field observations five ecological stands were selected as representative types of plantations in the Central Moldavian Plateau located in Vaslui county:

- Fereşti - Săratu (46°45′59.35″N and 27°42′47.11″E) mixed plantation of acacia dominant (about 5 years old), Western exposition (1);

-Fereşti - Velniţa (46°47′28.10″N and 27°43′51.29″E) mixed plantation of acacia dominant (about 5 years old), western exposition (2);

-Burcel's Hillock (46°51′17.64″N and 27°47′54.39″E) – acacia plantation of about 20 years, western exposition, grassy (3);

-Buhăieşti (46°47′34.40″N and 27°34′27.41″E) mixed plantation of acacia (10 -15 years) and *Pinus nigra* (about 50 years old) (4);

- Soleşti (46°50′1.23″N and 27°47′43.04″E) (mixed plantation of *Salix alba* (about 30 years old) and *Populus alba* (about 5 years old) (5);

The samples of 100 cm^2 each have been taken over in every stand. The extraction of fauna from the soil samples was made by the selective Tullgren - Berlese`s method. The analysis of oribatid and gamasid communities' structure was based on the analytical ecological indices: average abundance in individuals/100cm^2 calculated both on species (ā) and global (Ā), number of species S, relative density - D.r. expressed in the classes I (subrecedent under 1%), II (recedent 1.1-2%); III (subdominant 2.1-5%), IV (dominant 5.1-10%), and V (eudominant over 10%) (Rajski A., 1961).

RESULTS AND DISCUSSIONS

The gamasid mites' fauna found in forest plantations from Central Moldavian Plateau consisted of 138 individuals belonging to 21 species, 12 genera and 9 families. The number of taxa is slightly lower than in plantations from the Moldavian Plain as regards the species and genera, but the same as the number of families. The comparison indicates a high percentage of common families (88%); the difference is given by the families *Ameroseiidae* and *Zerconidae*, the first one being identified only in plantations from Central Moldavian Plateau, and the second one only in those of Moldavian Plain. In the investigated ecosystems representation of the families is not a balanced one. Thus, most of the genera and species belong to *Hypoaspididae* family (two genera and eight species, namely 37% of all species).The next places are occupied by *Phytoseiidae* with only two genera and two species (10% of all species) and *Veigaiaidae* with one genus and three species (13% of all species). Previous researches developed in similar ecosystems from the Moldavian Plain has shown that families representation is more balanced, here about 67% of them owning similar number of species. It was found that three families comprising 15% each from the total number of species (*Veigaiaidae, Parasitidae, Phytoseiidae*), and three others 12% (*Ascidae, Rhodacaridae, Hypoaspididae*) (Călugăr A., 2010).

Zoogeographical analysis revealed the following categories: strictly European species (47.6%), species whose area includes Europe and another continent (9.52%), Palaearctic species (14.3%), Holarctic species (9.52%) and others (about 19%). In terms of autecological peculiarities praticolous species and mainly praticolous ones are the most numerous (about 33%), followed by silvicolous species, mainly silvicolous and euryplastic species (about 10% each). Mesophilous and meso-higrophilous species represent approximately 20% of all identified species (Bregetova N. G. et. al., 1977, Karg W, 1993 Salmane I., Kontschan, J., 2005).

In the context of the present study was recorded a new species for the Romanian fauna *Hypoaspis heselhausi* Oudemans, 1912 and two rare species less cited - *Paragarmania dendritica* (Berlese, 1918) and *Hypoaspis brevipilis* Hirschmann, 1969. A comparison between the taxocoenosis of gamasid mites from the five stands considered in this study put into evidence certain differences both from abundance and number of species. Thus, the greater value of the abundance is registered at Buhăieşti (47% of the total number of individuals), followed by Fereşti - Săratu stand (29%). The smallest number of individuals is noticed in Soleşti stand where only 2% of total number of individuals was found (*fig. 1*). These differences are due to the peculiar stand conditions (type of plantation, age, soil type, etc.) and anthropogenic pressures to which they are subjected.

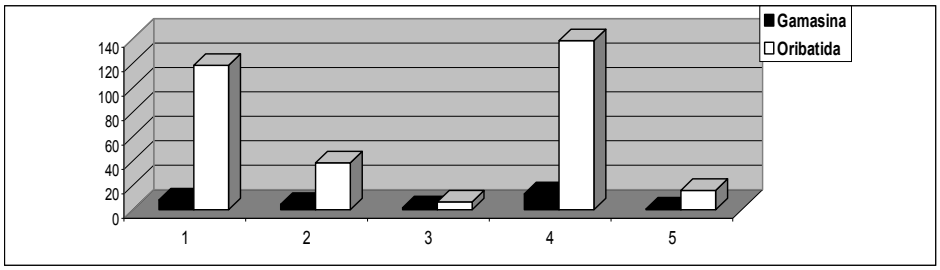

Figure 1 **Average abundance (individuals/100cm^2)**
(1-5, stands as mentioned in Material and method**)**

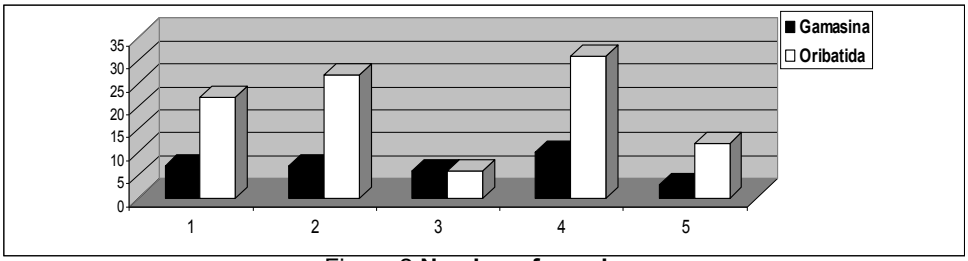

Figure 2 **Number of species**

In mixed plantation at Buhăieşti the family *Veigaiaidae* is better represented (comprising 44% of effectives), followed by *Hypoaspididae* (24%), and finally by *Pachylaelaptidae, Phytoseiidae, Pseudolaelapidae*, *Ascidae* (cumulating 32% of individuals). At Fereşti – Velniţa the families *Parasitidae* with 47% and *Veigaiaidae* with 24% holds the majority of individuals. At Soleşti these two families are the only ones from community structure - *Veigaiaidae* with 67% and *Hypoaspididae* with the rest of the individuals. In Fereşti – Săratu plantation the family with the largest number of individuals is *Parasitidae* (66%), followed by *Veigaiaidae* with 18%; the families *Pachylaelaptidae* and *Ascidae* have 8% each. At Soleşti *Veigaiaidae* family owns 67% of individuals, the remains being identified as belonging to the *Hypoaspididae* family. In the acacia plantation from Burcel's Hillock *Hypoaspididae* have the highest representation with 49%, followed by *Phytoseiidae* with 38% and then by *Pseudolaelapidae* with 13%.

As regards the number of species, the highest has been identified at Buhăieşti, with nearly half of all recorded species, followed by Fereşti - Velniţa and Fereşti – Săratu, with 33% each (*fig. 2*).

Representation of the main families from the number of species point of view indicates that in the plantation from Buhăieşti *Hypoaspididae* holds 30% of all species found here, followed by *Veigaiaidae* and *Phytoseiidae*, with 20% each. At Fereşti - Velniţa *Hypoaspididae* and *Veigaiaidae* are represented each by 29% of all species and the remaining families only by 14% each. At Fereşti-Săratu three families have a similar representation: *Veigaiaidae* with 28%, *Pachylaelaptidae* and *Parasitidae* with 29% each; the rest of 14% is hold by Ascidae. In the mixed plantation from Soleşti the *Hypoaspididae* family have 67% and *Veigaiaidae* 33%. At Burcel's Hillock *Hypoaspididae* hold half of the species, the rest being divided between *Phytoseiidae* (33%) and *Pseudolaelaptidae* (17%).

So, based on the discussed data just a few families have a good representation both as number of species and number of individuals, for instance *Parasitidae* (at Fereşti-Săratu) and *Hypoaspididae* (Burcel's Hillock).

Analysis of community structure based on the relative density of species in each stand indicated that approximately 81% of species are eudominant and / or dominant (*tab. 1*). Among these, as common elements for the examined plantations, only two species are present in the majority of the stands, both species known from the literature data as having a wide ecological plasticity (Karg W., 1993). Thus *Veigaia nemorensis*, an euribiont species is found, with the exception of Burcel's Hillock plantation in all stands, being eudominant at Fereşti Săratu and Soleşti and dominant at Buhăieşti. The second one - *Hypoaspis aculeifer* also an euryplastic element is common to three of the analised stands (Fereşti Velniţa, Buhăieşti and Soleşti) being eudominant in Buhăieşti and Soleşti and dominant at Fereşti Velniţa. Also, it is noted that 38% of the identified are common to two of them. Besides the common species, the analysis showed for each stand a number of own species, identified in only one plantation (*tab. 1*).

Oribatid mites, the second group considered in this study, are distinguished by their density, richness in species, and taxonomic diversity. Study of the faunistic material from the five forest plantations (1568 specimens in all) resulted in identification of 59 species, belonging to 41 genera and 28 families of the suborder *Oribatida* Dugès, 1834.

The major groups are represented throughout the oribatid fauna as follows: primitive oribatids – 13.56% of the total number of species, superior, picnonotic oribatids – 50.85%, and poronotic ones – 35.59%. Increased proportion of the picnonotic oribatids is characteristic of forest ecosystems (Aoki J., 1983; Ivan O., Vasiliu M., 2000). In the taxonomical spectrum, some families are remarked by their representation, namely: *Oppiidae* (9 genera, 12 species), *Suctobelbidae* (1 genus, 5 species), *Protoribatidae* (2 genera, 4 species), *Scheloribatidae* (1 genus, 4 species).

Analysis of the zoogeographical spectrum of the fauna shows that Holarctic elements are most numerous (27.1%), followed by Palaearctic species (23.7%), cosmopolitan and semi-cosmopolitan (23.7%) and European species (22%). About 50% of the European species are southern elements, occurring here at the northern limit of their areal (Subias L. S., 2004, 2013; Vasiliu N. et al., 1993).

As regards species' autecology, closed proportion of the grassland species and euryplastic ones (20.3% respectively 18.6%) could be noticed, while silvicolous species represent only 16.9% of total. In terms of species requirements in relation to the moisture factor, fauna has, overall, a mesophilic character. However, thermo-xerophilous elements, that represent about 15% of species, are a significant part of oribatid communities (Perez-Iñigo C., 1993; Rajski A., 1967, 1968; Weigmann G., 2006).

Table 1

Distribution of eudominant and dominant species in the investigated forest plantations

Taxa	Stands				
Acari Nitzsch, 1818	1	2	3	4	5
Gamasina Leach, 1815					
- *Veigaia nemorensis* C. L. Koch, 1839	a	c		b	a
- *Hypoaspis aculeifer* (Canestrini, 1883)		b		a	a
- *Pergamasus primorellus* Athias Henriot, 1967	b	a			
- *Veigaia planicola* Berlese, 1892		a		a	
- *Olopachys suecicus* Sellnick, 1950	c			b	
- *Hypoaspis vacua* (Michael, 1891)		b	a		
- *Pseudolaelaps doderoi* (Berlese, 1910)			a	a	
- *Amblyseius cf. obtusus* (C. L. Koch, 1839)			a	b	
- *Paragarmaia dendritica* (Berlese, 1918)			a	c	
- *Asca nova* Willmann, 1939	a				
- *Pachylaelaps magnus* Halbert, 1915	a				
- *Pergamasus canestrinii* (Berlese, 1884)	a				
- *Rhodacarus denticulatus* Berlese, 1921		a			
- *Hypoaspis karawaiewi* (Berlese, 1903)			a		
- *Laelaspis astronomicus* (C. L. Koch, 1839)			a		
- *Hypoaspis brevipilis* Hirschmann, 1969				b	
- *Hypoaspis praesternalis* Willmann, 1949					a
Oribatida Dugès, 1834					
- *Anomaloppia differens* Mahunka et Topercer, 1983	a	b	b	a	
- *Ramusella (I.) insculpta* (Paoli, 1908)	a	c	a	a	
- *Tectocepheus velatus* (Michael, 1880)	b	b	a	c	b
- *Scheloribates (S.) labyrinthicus* Jeleva, 1962	c	b			a
- *Oribatula (Z.) glabra* (Michael, 1890)			a	c	
- *Punctoribates ghilarovi* Shaldybina, 1969		a			
- *Ceratozetes (C.) minutissimus* Willmann, 1951		a			
- *Heminothrus (P.) peltifer* (Koch, 1839)					a
- *Galumna (G.) lanceata* (Oudemans, 1900)	c	c	b	c	c
- *Suctobelbella (S.) acutidens* (Forsslund, 1941)	c			b	
- *Suctobelbella (S.) subcornigera* (Forsslund, 1941)	c			b	
- *Fosseremus laciniatus* (Berlese, 1905)		c		b	
- *Suctobelbella (S.) subtrigona* (Oudemans, 1900)				b	
- *Subiasella (L.) subiasi* (Mahunka, 1987)					b
- *Achipteria (A.) coleoptrata* (Linné,1758)					b
- *Protoribates (P.) lophotrichus* (Berlese, 1904)					b

LEGEND: 1 - Fereşti-Săratu; 2 - Fereşti- Velniţa; 3 - Movila lui Burcel; 4 – Buhăieşti; 5 – Soleşti

a - species with relative density >10%; b - species with relative density between 5.1-10%; c - species with relative density <5%; d - absent

a
b
c
d

In the context of the present study *Oribatella (O.) similesuperbula* Weigmann, 2001 was reported for the first time in Romanian fauna, alongside of a number of rare, less cited species in our country as *Berlesezetes ornatissimus* (Berlese, 1913), *Mystroppia sellnicki* Balogh, 1959, *Liacarus (D.) zachvatkini* Kulijev, 1962. The first two species are at the second record, being identified as new species for the country fauna in meadows of the same area (Ivan O., 2010). *L. zachvatkini* is a Caucasian element, which in Romania is recorded probably at the western boundary of its areal (it is recorded now third time in meso-xerophilous habitats in the east of the country) (Subias L. S., 2004, 2013; Ivan, 2010).

Analysis of global structural parameters of the oribatid communities highlights differences from one stand to another, both in terms of global average abundance and number of species, these parameters being closely related to the age and type of forest plantation. In mixed plantations with age over 10 years (Buhăieşti) mites fauna is more diverse and average abundance is higher than in very young plantations (Fereşti). The values found in these ecosystems are lower than in the Moldavian Plain forest plantations, but are comparable with those estimated in some grasslands from the Central Moldavian Plateau (Ivan O., 2007, 2010).

Analysis of distribution of the oribatid species with important numerical weight (*tab. 1*) reflects environmental conditions specific to each analyzed stand, so only two of them (*Tectocepheus velatus* and *Galumna lanceata*) are

present in all forest plantations and other two in four stands (*Anomaloppia differens* and *Ramusella insculpta*). Noteworthy is distinctive composition of the eudominant and dominant species group in Solesti plantation, where predominate mesophilous and meso-hygrophilous elements, such as: *Heminothrus peltifer, Subiasella (L.) subiasi, Protoribates lophotrichus*.

Among the eudominant and dominant species there are euryplastic elements (*Ramusella (I.) insculpta, Tectocepheus velatus, Achipteria coleoptrata, Suctobelbella subcornigera*), as well as grassland species (*Scheloribates labyrinthicus, Oribatula (Z.) glabra*).

Comparative analysis of the global parameters of the oribatid and gamasid communities (number of species, global average abundance) showed that oribatid mites represent the dominant group, in all the analyzed plantations, particularly in terms of abundance (*fig. 1, 2*), situation frequently encountered also in natural forest ecosystems (Călugăr A., 2010; Huţu M., Bulimar F., 1993; Ivan O., 1995, 2007).

As regards the number of species gamasid mites were represented by a number of species 3-4 times lower than oribatids, except the acacia plantation at Burcel's Hillock, where it was identified the same number of species (*fig. 2*).The abundance of gamasid mites was also lower than that of oribatids, the values found in all analyzed plantations being 4-26 times lower (*fig. 1*).

CONCLUSIONS

Edaphic mites fauna (*Acari: Gamasina, Oribatida*) of the forest plantations under investigation comprises in close proportions praticolous and euryplastic species, the sylvicolous forms being poorly represented.

In the context of the present study were recorded two new species for Romanian fauna: *Hypoaspis heselhausi* Oudemans, 1912 and *Oribatella (O.) similesuperbula* Weigmann, 2001 together with a number of rare, less cited species.

Structural parameters of edaphic mites communities are closely related to the age and type of plantation; in mixed plantations with age over ten years, edaphic mites fauna is more diverse and more abundant than in very young plantations.

The anthropic pressure, and certain limiting factors occurring in some stands are reflected at the level of edaphic mites communities by reducing the global abundance and number of species, thus affecting their stability and functioning of the ecosystem as a whole.

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